Tsunami Countermeasure in Japan
-Education, awareness, and tsunami warning

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History of tsunamis, education and awareness in Japan

Tsunamis in Japan have been frequently generated by under-water earthquake, volcano, and landslide at the zone of subduction in the ocean plates, causing the serious damage which has been reported since A.D.684 (Hakuo). The number of tsunamis in Japan exceeds 195 during the period of 1,313 years, meaning their frequency becomes one event every 6.7 years, which is much less than floods or earthquakes. This is why the awareness of tsunamis among Japanese is low, and why it is difficult for many to understand tsunamis.

We have the knowledge, experiences and regional countermeasure to reduce damage of tsunamis in Japan. How can we make action to remind the experience for long time ? How can we mitigate damage in the wide coastal area ? There are both hard and soft countermeasure; breakwater, sea-wall, tsunami memorial and history of heroes are introduced to be shared with us.

Although the most important rule is to evacuate as soon as a tsunami is generated, it is rather difficult to keep a consciousness and to prepare rapid action at anytime for a tsunami on some day. A hazards map with the risk information on the common bases has been made by not only experts and governments but also residents and NGO in order to compile the data and information as much as possible.

The great Sanriku tsunami of 1896 that occurred at Karakuwa, Miyagai, Japan, documented in Fuzoku-gahou, illustrated magazine

Power of a tsunami causes huge human-loss in the coastal area. After the weak ground quake around 8 pm, June 15, 1896, a huge tsunami struck the coast of Sanriku, resulting in more than 20,000 casualties which is the worst of its kind of Japanese history.

Tsunami memorials at Jyodogahama coast in Miyako city, Sanriku, Japan

Two memorials for the 1933 Sanriku and the 1960 Chilean tsunamis are placed along the coast. The first reminds us to evacuate to a higher and safer place when an earthquake is followed by strong ground quake, and the second urges to evacuate even when receding wave is observed without any ground quake, because the 1960 tsunami was generated by the earthquake in the far-field. Another type of tsunamis was observed in the 1983 that is the short wave forming bore with powerful wave force. As this indicates, tsunamis depend on the source, location and generated wave period.


Workshop with the local residents to raise tsunami awareness through the drawing of hazards map

The information and warning of tsunami after an earthquake is crucial but not enough. Constant awareness of ground levels and dangerous areas, as well as safe zones, is necessary for an adequate response. Importance to developing this awareness is knowledge of historical tsunamis and their aftermath.

Tsunami Warning System in Japan

Japan, surrounded by seas, is one of the most tsunami-prone countries in the world, and has suffered from serious tsunami disasters. Considering such circumstances, Japan Meteorological Agency (JMA) has been implementing seismological observation since 1880s, and initiated tsunami warning services in 1952. JMA maintains the nation-wide seismic network composed of 180 stations at present. Continuous seismic waveform data at these stations are sent via dedicated telephone lines to six Regional Tsunami Warning Centers (Fig. 1), and processed in real time. Seismic activities are monitored 24 hours a day, 7 days a week. When an earthquake occurs, the event will be automatically detected and checked in a man-machine interactive manner. Within three to five minutes after the occurrence of the earthquake, tsunami forecast and related information will be issued, if necessary. It is very important to improve the accuracy of tsunami forecast and to reduce false alarm. In order to estimate a possibility of tsunami generation using quickly determined hypocenter and magnitude of the earthquake, JMA introduced a numerical simulation technique in April 1999.

Even a state-of-art computer will require much time to calculate tsunami generation and propagation. Alternatively, JMA calculated tsunami generation and propagation for 100,000 different cases (epicenter,depth, magnitude and fault geometry) in advance on an offline basis. Results of the simulation, namely, estimated tsunami heights and arrival times along the coast, are stored as a database. When a large earthquake occurs, the most appropriate case for an actual location and a magnitude of the earthquake is retrieved from the database. Using the retrieved data, tsunami warnings or advisories, for sixty-six forecast coastal regions of Japan are automatically made by the computers at Regional Tsunami Warning Centers (Fig. 2), then disseminated via land line and satellite to relevant organizations and the public.

JMA has started to provide Tsunami Watch Information (TWI) for Indian Ocean countries on their demand, in coordination with the Pacific Tsunami Warning Center, as an interim measure until the Tsunami Early Warning System is established in the Indian Ocean. TWI is to be provided at the occurrence of a large earthquake in the Indian Ocean, and conveys information on the earthquake and the possibility of tsunami generation. In the case of earthquakes with magnitude greater than 7.0, it also conveys estimated tsunami travel time to 43 segmented coastal zones of the Indian Ocean.

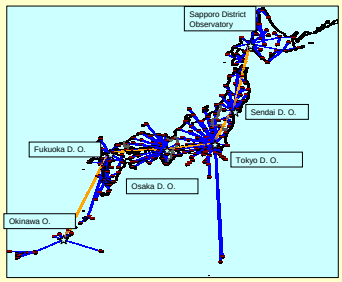

Fig.1 Seismic data transmission network of JMA

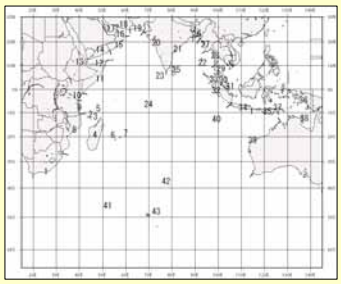

Fig.3 Coastal zones where estimated tsunami travel time is conveyed in TWI

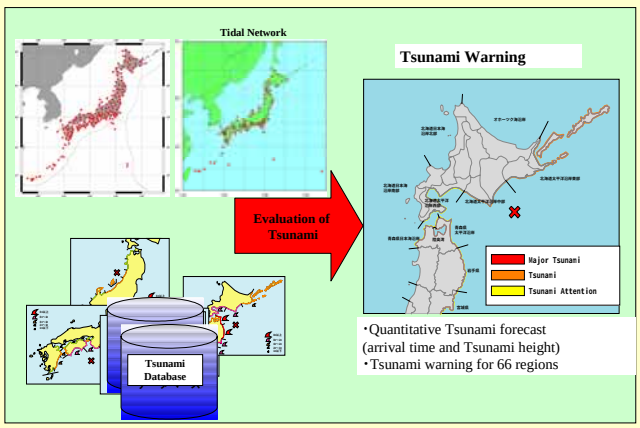

Fig.2 Tsunami forecast operation of JMA